



Study the Strength of Concrete Made using Brick Kiln Dust as Partial Replacement of Fine Aggregate

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Abstract

Concrete is versatile and commonly used material in construction and composed of cement, fine aggregate, coarse aggregate and water. To fulfil the necessity of fast growing population and enhance the life style of society construction work fast forwarded around the globe. Because of which the real imbalance of natural resources is at peak. Therefore, in order to control the imbalance, human has started to use alternative sources of material in construction industries. In this sequence, there are plans to utilize the waste materials, by-products obtained from different industries and construction and demolition waste in construction field. Brick kiln dust may be one of them which are obtained from brick kiln. In present investigation an experimental programme was carried out to study the suitability and potential use of brick kiln dust as a partial replacement of fine aggregate in concrete. To achieve this specimen were casted for different replacement level at an interval of 5 percent to determine workability, compressive strength and splitting tensile strength of concrete at different level of fine aggregate with brick kiln dust. Results show that optimum replacement with brick kiln dust is 15 percent based on compressive and splitting tensile strength.

Keywords: Brick kiln dust; Compressive strength; Fine aggregate; Splitting tensile strength; Workability.

1. INTRODUCTION

Clay brick manufacturing is much unorganized sector in India. Disposal of garbage generated from this sector is a very terrible problem due to which environment becomes polluted and people suffer from respiratory diseases. To save the environment and effective disposal of this dust, use of brick kiln dust in concrete is one of the solution. For that an experimental programme was carried out to study the suitability and potential use of brick kiln dust as partial replacement of fine aggregate in concrete. To accomplish these specimens were casted for different replacement level at an interval of 5 percent to determine workability, compressive strength and splitting tensile strength of concrete at different percentage level of fine aggregate with brick kiln dust. The percentage of brick kiln dust was gradually increased in concrete and investigates its effect in sense of workability, compressive strength and splitting tensile strength. The study shows that the compressive strength and splitting tensile strength of concrete made using brick kiln dust as a partial replacement of fine aggregate having larger value at 15 percent partial replacement level in comparison of conventional concrete whereas the workability of concrete was gradually decreased with the increment of brick kiln dust in concrete. It may be due to the more water absorption capacity of

brick kiln dust in comparison of natural aggregate or lack of surface moisture.

2. MATERIALS AND METHODS

2.1. Cement

Ultratech brand name Portland Pozzolana Cement (fly ash based) confirming to IS 1489 (Part 1) – 1991 single lot was used in this investigation. The properties are shown in table 1.

Table 1. Properties of Cement

S. No.	Properties	Findings
1.	Standard Consistency	31%
2.	Initial Setting Time	210 minutes
3.	Final Setting Time	315 minutes
4.	7 days Compressive Strength	33 N/mm ²
5.	28 days Compressive Strength	44 N/mm ²
6.	Specific Gravity	2.9

2.2 Fine Aggregate

Locally available river sand in Prayagraj confirming to IS 383-1997, zone III used in this study. Fineness modulus and specific gravity of this material was 2.76 and 1.78 respectively.

2.3. Coarse Aggregate

Locally available coarse aggregate of 20 mm nominal size individually sieved was used in the study. The specific gravity of coarse aggregate was 2.67 and fineness modulus was 7.7.

2.4. Brick Kiln Dust

A waste material obtained from brick kiln locally in Prayagraj confirming to IS 383-1997, zone III used in this study. Fineness modulus and specific gravity of this material was 2.5 and 2.5 respectively.

M25 grade of concrete is used as a benchmark which was designed as per IS 10262 -2009 guidelines. The proportion of materials was 1:1.2:2.5 with water cement ratio 0.45. Total 48 specimen cubes of size 150 mm and 36 specimen cylinders of size 150 mm in diameter and 150 mm in height were casted for this investigation. Initially 12 cubes of size 150 mm were casted for mix design calculation contained 380 kg cement per cubic meter of concrete with varying water cement ratios. Then 36 cube and 36 cylinder specimens were casted for replacement of brick kiln dust with fine aggregate at different percentage. For a percentage replacement 6 cubes and 6 cylinders were casted, 3 for 7 days and 3 for 28 days strength calculation. The cube and cylinder was filled in two parts with manually mix mixture and vibrated on a table vibrator. Workability of fresh concrete was measured by slump cone. Uniformity and accuracy was maintained during mix preparation and test. After 24 hours of casting specimens were demoulded and put in water bath for curing. The compressive strength and splitting tensile strength of concrete for 7th days and 28th days were tested on compression testing machine confirm to IS 14858 - 2000 of capacity 2000kN.

3. RESULTS AND DISCUSSION

3.1 Workability

The workability of fresh concrete was measured by slump cone test. The slump cone test indicates the behavior of a compacted concrete cone under the action of gravitational forces. Slump values for different percentage of brick kiln dust in concrete mix are tabulated in table 2 and graphical view shown in figure 1.

Table 2. Workability of Concrete

S. No.	Percentage of brick kiln dust in concrete	Slump value
1	0	75
2	5	68
3	10	62
4	15	57
5	20	54
6	25	54

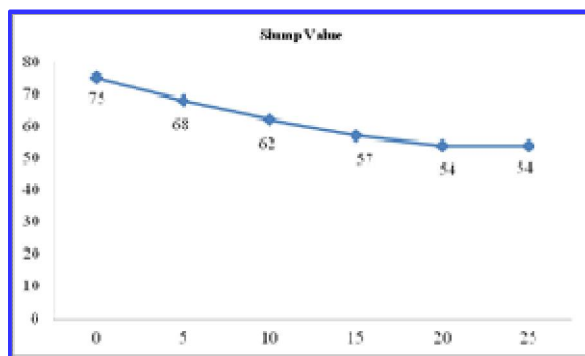


Fig. 1: Workability of Concrete

Result indicates that on increment in percentage of brick kiln dust in place of natural sand the workability of mix is gradually decreases and maximum workable concrete obtained with no percentage of brick kiln dust in concrete mix.

3.2 Compressive strength test

Average compressive strength of three specimens was used for strength calculation. The average compressive strength of concrete for 7th days and 28th days were tested as per IS 516-2004 and results are tabulated in table 3 and graphical view shown in figure 2. The compressive strength of cube first increases and attains maximum strength after that the strength decreases rapidly with increase in percentage of brick kiln dust as a partial replacement of natural sand in concrete mix. At 15 percent partial replacement of brick kiln dust with natural sand attains maximum strength for 7th days and 28th days which is 16.5 percent and 16.6 percent more in comparison of concrete with no brick kiln dust.

Table 3. Compressive strength of concrete

S. No.	Percentage of brick kiln dust in concrete	Compressive strength of concrete	
		7 days	28 days
1	0	24.8	33.0
2	5	25.5	34.0
3	10	27.0	36.0
4	15	28.9	38.5
5	20	24.8	33.0
6	25	23.3	31.0

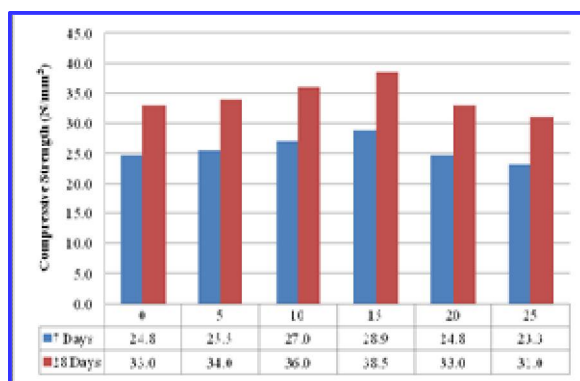


Fig. 2: Compressive strength of mortar mix

3.2. Splitting tensile strength

Average splitting tensile strength of three specimens was used for strength calculation. The average splitting tensile strength of concrete for 7th days and 28th days were tested as per IS 5816-1999 and results are tabulated in table 4 and graphical view shown in figure 3.

Table 4. Splitting tensile strength

S. No.	Percentage of brick kiln dust in concrete	Splitting tensile strength of concrete	
		7 days	28 days
1	0	2.25	3.00
2	5	2.32	3.09
3	10	2.45	3.27
4	15	2.63	3.50
5	20	2.25	3.00
6	25	2.11	2.82

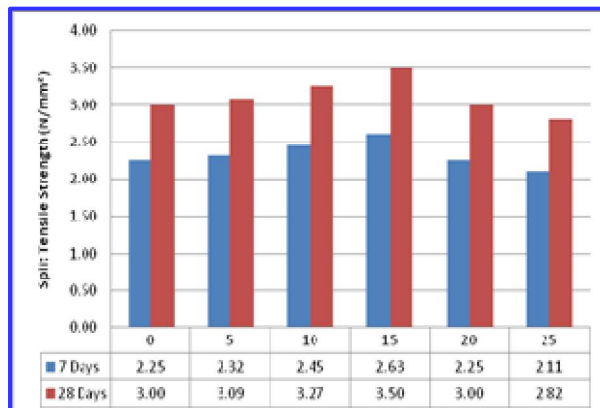


Fig. 3: Splitting Tensile Strength

The splitting tensile strength of cube first increases and attains maximum strength after that the strength decreases rapidly with increase in percentage of brick kiln dust as a partial replacement of fine aggregate in concrete mix. At 15 percent partial replacement of natural sand with brick kiln dust attains maximum strength for 7th days and 28th days which is 16.8 percent and 16.6 percent more in comparison of concrete with no brick kiln dust.

4. CONCLUSION

Based on experimental investigations following points can be concluded.

- The workability of concrete mix decreases rapidly with increase in partial replacement of natural sand with brick kiln dust.

- The strength of concrete made using brick kiln dust as a partial replacement of fine aggregate first increases, attains maximum at 15 percent replacement level and then decreases gradually.
- The variation in strength is within 16.8 for concrete with brick kiln dust in respect to concrete without brick kiln dust.
- The decreased workability of mix can be managed by using a dose of superplasticizer in mix.

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